Open Grid Forum 28
March 15-18, 2010
Munich, Germany

Using the OGF OCCI Interface on OpenNebula/RESERVOIR

Constantino Vázquez Blanco

dsa-research.org

Distributed Systems Architecture Research Group
Universidad Complutense de Madrid

dsa-research.org

Contents

- OpenNebula Overview
- Cloud Taxonomy
- The RESERVOIR Project
- OGF OCCI OpenNebula Implementation
- Hands On

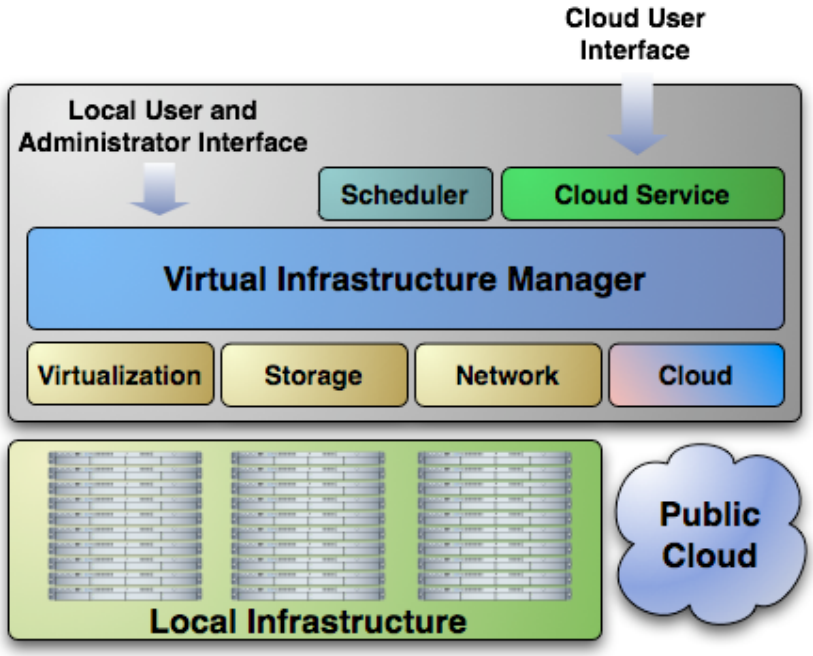
OpenNebula Overview

OpenNebula Overview

What is OpenNebula?

Open-Source Toolkit for Building Cloud Infrastructures

- Orchestrates storage, network and virtualization technologies to enable the dynamic placement of multi-tier services on distributed infrastructures, combining both data center resources and remote cloud resources, according to allocation policies
- Provides internal and Cloud administration and user interfaces for the full management of the IaaS Cloud platform



Private Cloud: Management of virtual infrastructure in the data-center or cluster

Hybrid Cloud : Combination of private with Cloud resources

Public Cloud: Cloud interfaces for the full management of services

OpenNebula Overview

Benefits

For the Infrastructure Manager

- Centralized management of VM workload and distributed infrastructures
- Support for VM placement policies: balance of workload, server consolidation…
- Dynamic resizing of the infrastructure
- Dynamic partition and isolation of clusters
- Dynamic scaling of private infrastructure to meet fluctuating demands
- Lower infrastructure expenses combining local and remote Cloud resources

For the Infrastructure User

- Faster delivery and scalability of services
- Support for heterogeneous execution environments
- Full control of the lifecycle of virtualized services management

OpenNebula Overview

Benefits

For System Integrators

- Fits into any existing data center, due to its open, flexible and extensible interfaces, architecture and components
- Builds any type of Cloud deployment
- Open source software, Apache license
- Seamless integration with any product and service in the cloud ecosystem and management tool in the data center, such as
  - cloud providers
  - VM managers
  - virtual image managers
  - service managers
  - management tools
  - schedulers

dsa-research.org

OpenNebula Overview

Ecosystem

Related Technologies

- Haizea (Uchicago): Open-source VM-based lease management architecture
- Several tools for service elasticity management, VM scheduling… being developed around OpeNebula in RESERVOIR (IBM, Telefonica I+D,…)

Infrastructure Technology

- KVM Management Tools
- Xen Community Project

Cloud Services

- Technology Partner of ElasticHosts
- Project in the Amazon EC2 Solutions Catalog

Cloud Solutions and Tools

- Libvirt CLI and Desktop Applications

Open-source Distributions

- Ubuntu 9.04 (Jaunty Jackalope)
- Chapter on Cloud Technologies in the Morfeo open-source community

Standardization Bodies

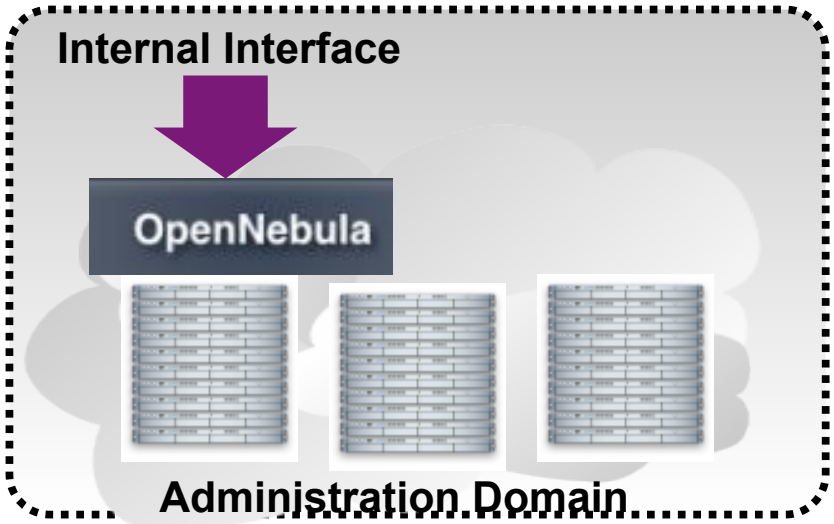
- **OGF Open Cloud Computing Interface**

Cloud Taxonomy

Cloud Taxonomy

Private Cloud

- The infrastructure is owned and used by a single organization
- Private clouds enable a flexible and agile management of local infrastructure
- Not a new model, datacenter management has been around for a while
- Internal interfaces expose additional functionality for managing virtualized resources and controlling data center operation, not exposed by cloud interfaces
- Cloud interfaces may be also provided for users requiring higher abstraction



- Centralized management
- VM placement optimization
- Dynamic resizing and partitioning of the infrastructure
- Support for heterogeneous workloads

dsa-research.org

Cloud Taxonomy

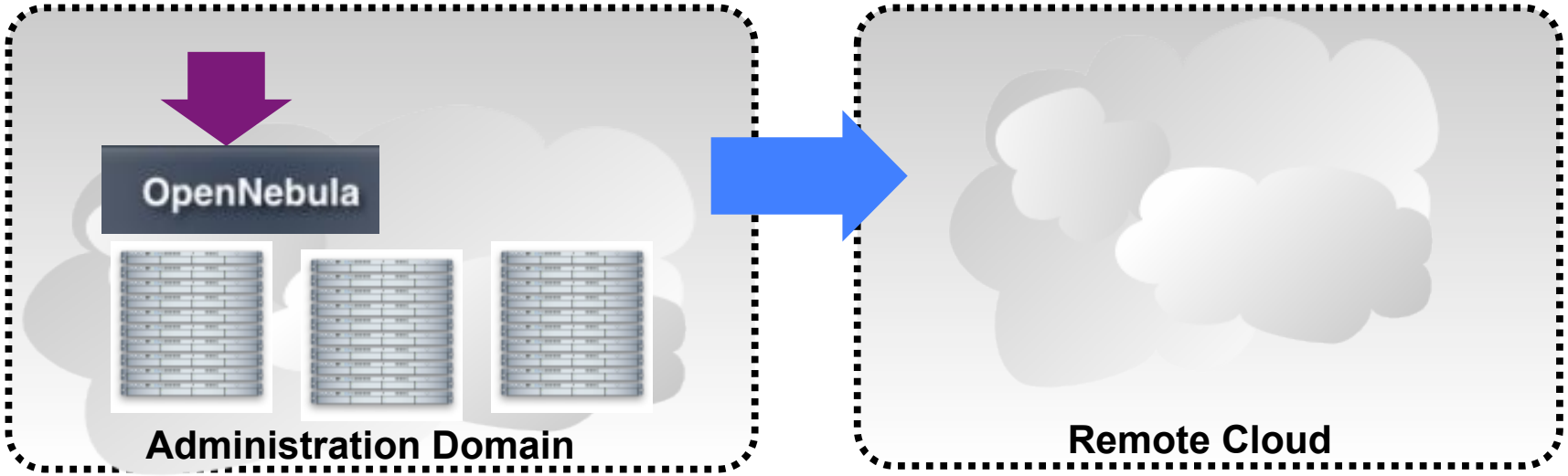
Private Cloud

Feature	Function
Internal Interface	• Unix-like CLI for fully management of VM life-cycle and physical boxes • XML-RPC API and libvirt virtualization API
Scheduler	• Requirement/rank matchmaker allowing the definition of workload and resource-aware allocation policies • Support for advance reservation of capacity through Haizea
Virtualization Management	• Xen, KVM, and VMware • Generic libvirt connector (VirtualBox planned for 1.4.2)
Image Management	• General mechanisms to transfer and clone VM images
Network Management	• Definition of isolated virtual networks to interconnect VMs
Service Management and Contextualization	• Support for multi-tier services consisting of groups of inter-connected VMs, and their auto-configuration at boot time
Security	• Management of users by the infrastructure administrator
Fault Tolerance	• Persistent database backend to store host and VM information
Scalability	• Tested in the management of medium scale infrastructures with hundreds of servers and VMs (no scalability issues has been reported)
Installation	• Installation on a UNIX cluster front-end without requiring new services • Distributed in Ubuntu 9.04 (Jaunty Jackalope)
Flexibility and Extensibility	• Open, flexible and extensible architecture, interfaces and components, allowing its integration with any product or tool

Cloud Taxonomy

Hybrid Cloud

- **Extension of Private Clouds to** combine private with public Cloud-based infrastructure to enable highly scalable hosting environments
- Access to remote cloud is **fully transparent** to private cloud users
- Hybrid Clouds enable the **dynamic scaling of capacity to meet peak or fluctuating demands**



dsa-research.org

Cloud Taxonomy

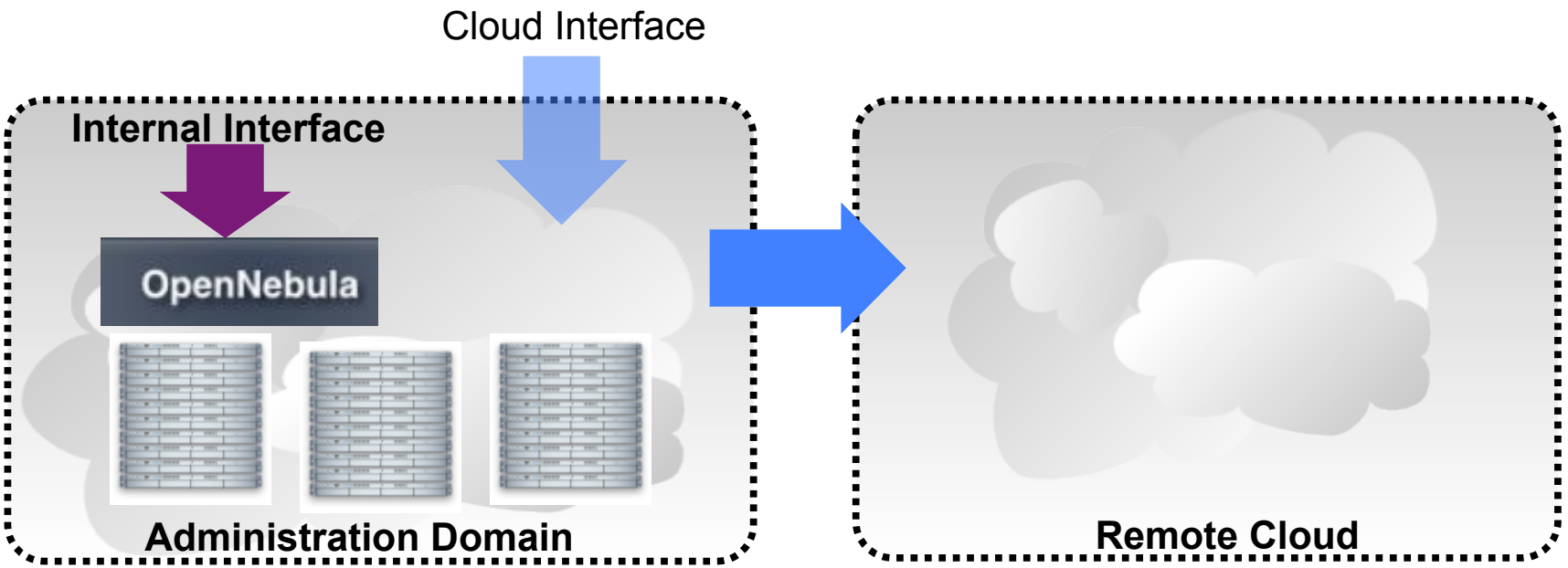
Hybrid Cloud

Feature	Function
Cloud Plugins	• Amazon EC2 and ElasticHosts connectors
Federation	• Support for simultaneous access to several remote clouds
Flexibility	• Modular approach to develop new connectors

Cloud Taxonomy

Public Cloud

- The infrastructure is **owned by a single commercial organization and used by customers**
- Public clouds enable the deployment of an entire IT infrastructure **without the associated capital costs, paying only for the used capacity**
- **Cloud interface:** Simple remote management of virtualized server instances



Cloud Taxonomy

Public Cloud

Feature	Function
Cloud Interfaces for Users	• Implementation of a subset of the EC2 Query API and the OGF OCCI API
Flexibility	• The new OpenNebula Cloud API allows the implementation of the new Cloud interfaces

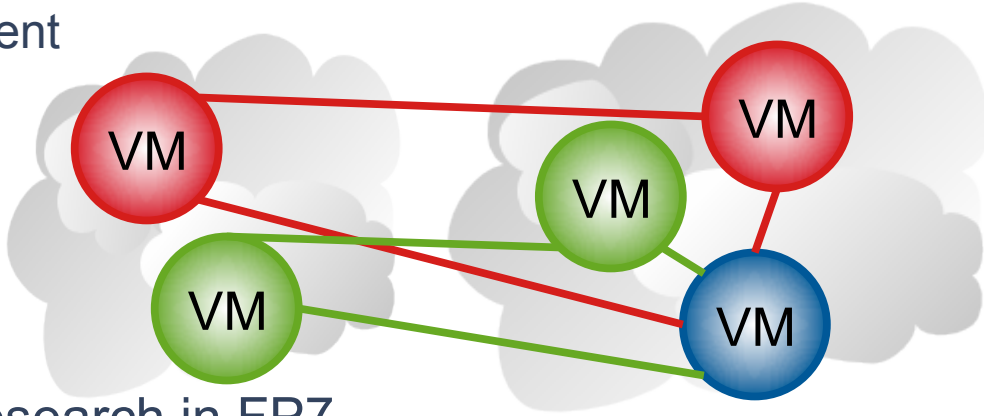
The RESERVOIR Project

The RESERVOIR Project

Overview

Resources and Services Virtualization without Barriers

- Open source technology to enable deployment and management of complex IT services across different administrative domains
- Functionality for Service Management
  - Definition
  - Lifecycle
  - Billing/accounting
  - Elasticity/SLAs



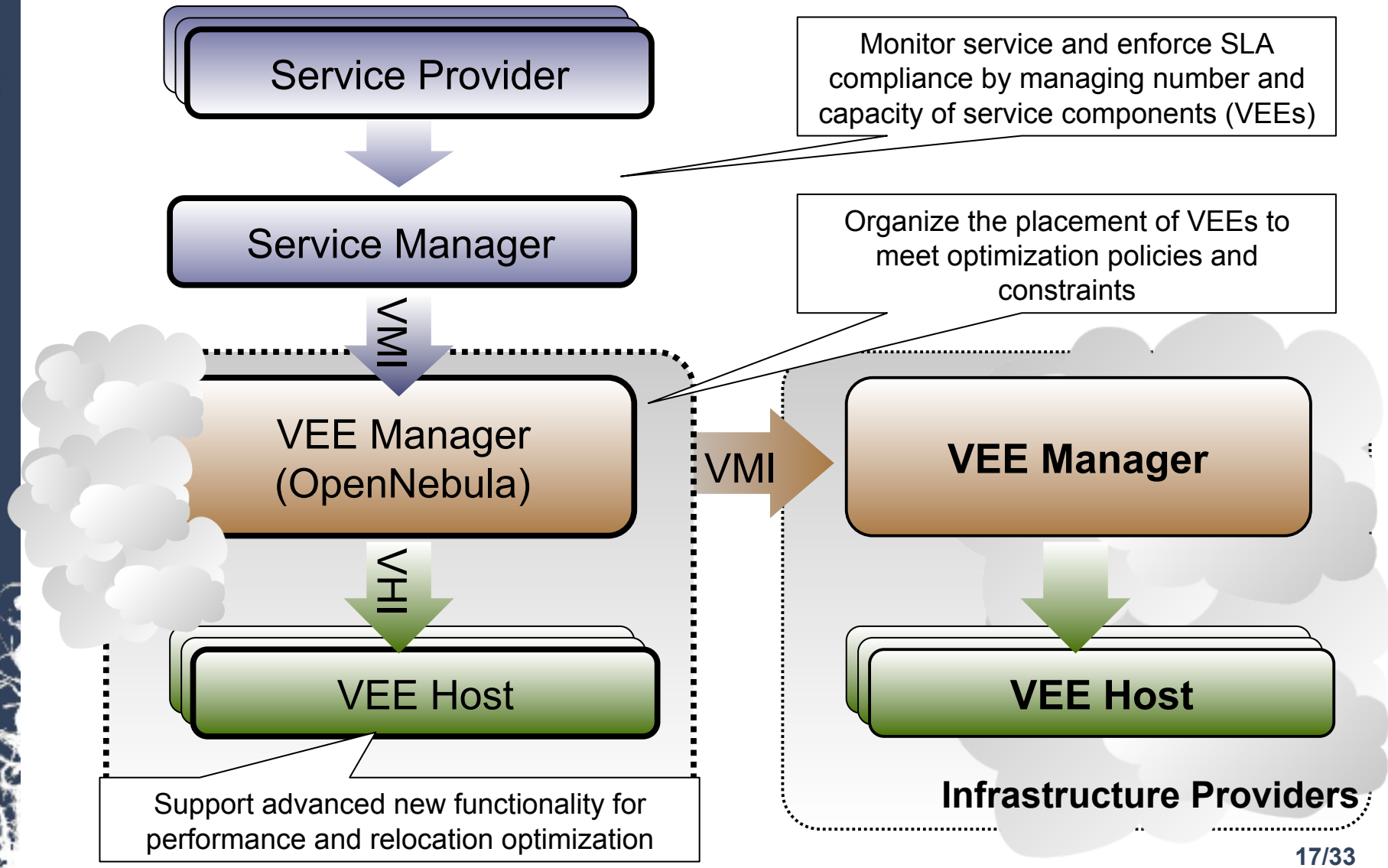
Flagship of Cloud Computing Research in FP7

- Focus on technologies that enable to build a federation of cooperating computing clouds
- A project driven by business use cases: SAP business application, Telco application, utility computing and eGov application
- 17-million and 3-year project partially funded by the European Commission
- Partners: IBM, Telefónica, UCL, Umea, SAP, Thales, SUN, Elsag Datamat, UCM, CETIC, University of Lugano, University of Messina, OGF.eeig.

The RESERVOIR Project

Organization

RESERVOIR Architecture

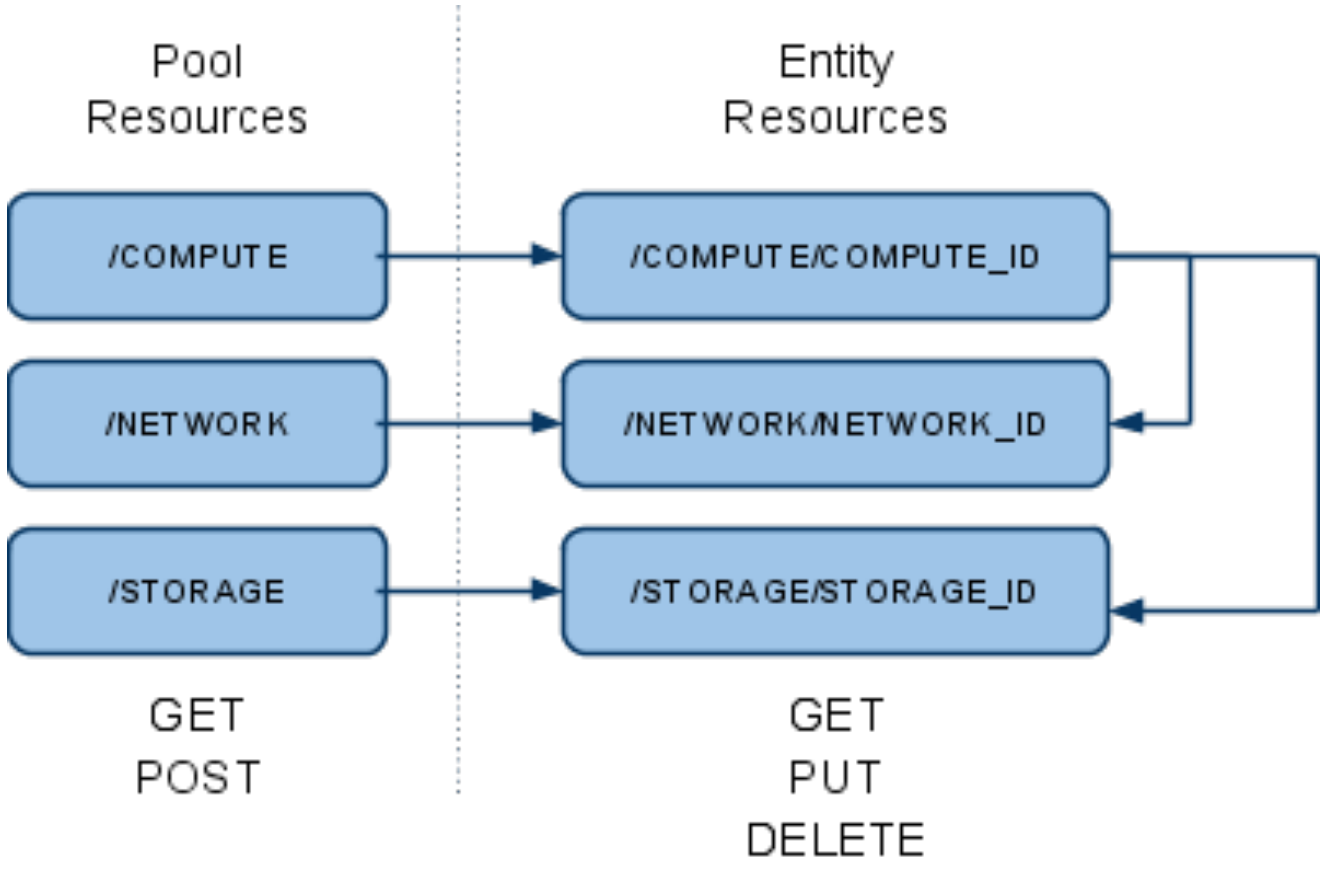


OpenNebula OCCI Design

OpenNebula OCCI Design

Overview

- OpenNebula OCCI RESTful web service
  - Launches and manages images, virtual networks and virtual machines
  - Uses an unfinished draft of the OGF OCCI API specification
    - Update planned for v1.6



OpenNebula OCCI Design

Pool Resources

The “COMPUTE” Pool

- HTTP Methods : GET, POST

```
<COMPUTES>
  <COMPUTE href="http://www.occi.org/compute/234">
  <COMPUTE href="http://www.occi.org/compute/432">
  <COMPUTE href="http://www.occi.org/compute/123">
</COMPUTES>
```

The “STORAGE” and “NETWORK” Pool

- HTTP Methods : GET, POST
- Similar structure

dsa-research.org

OpenNebula OCCI Design

Entity Resources

The “STORAGE” Object

- HTTP Methods : GET, DELETE

```
<DISK>
  <ID>123</ID>
  <NAME>Ubuntu 9.04 LAMP</NAME>
  <SIZE>2048</SIZE>
  <URL>file:///images/ubuntu/jaunty.img</URL>
</DISK>
```

The “NETWORK” Object

- HTTP Methods : GET, DELETE

```
<NETWORK>
  <ID>123</ID>
  <NAME>Blue Network</NAME>
  <ADDRESS>192.168.0.1</ADDRESS>
  <SIZE>C</SIZE>
</NETWORK>
```

OpenNebula OCCI Design

Entity Resources

The “COMPUTE” Object

- HTTP Methods : GET, PUT, DELETE

```
<COMPUTE>
  <ID>123AF</ID>
  <NAME>Web Server</NAME>
  <TYPE>small</TYPE>
  <STATE>running</STATE>
   <DISKS>
     <DISK image=http://www.occi.org/storage/234 dev=sda1/>
     <SWAP size=1024 dev=sda2/>
     <FS size=1024 format=ext3 dev=sda3/>
   </DISKS>
   <NICS>
     <NIC network=http://www.occi.org/network/123
ip="19.12.1.1"/>
     <NIC network=0/>
   </NICS>
</COMPUTE>
```

OpenNebula OCCI Design

Implementation choices

- OCCI Specification incomplete (at the time)
- Assumptions:
  - Representation format
    - XML
    - Resource attributes set by OpenNebula needs
  - Specification not clear about linking resources
    - XML nesting
  - Specification of local devices
    - OpenNebula uses unix devices with “dev” attributes
      - e.g. : <DISK image="ab5c9770-7ade-012c-f1d5-00254bd6f386" dev="sda1"/>
  - Management verbs not well defined (for stop, resume, etc)
    - Update representation through PUT chosen
      - More RESTful
      - Sometimes can be misleading
  - Storage POST not well defined
    - Upload image through HTTP multipart

OpenNebula OCCI Design

Command Line Interface

- Managing "**compute**" resources
  - occi-compute {create, list, show, update, delete}
- Managing "**network**" resources
  - occi-network {create, list, show, delete}
- Managing "**storage**" resources
  - occi-storage {create, list, show, delete}

Hands On

dsa-research.org

Hands On

Accounts

Server

https://devel.cloud.opennebula.org

Clients

```
$ ssh cloud02.dacya.ucm.es -l <user>
```

- user: “occiclient{01..40}”
- password: “ogfmunich”

dsa-research.org

Hands On

Prerequisites

- Software dependencies already installed
  - More details in

    http://opennebula.org/documentation:rel1.4:occicg

  - Cloud02 is a Ubuntu machine, for platform specific notes go to

    http://opennebula.org/documentation:rel1.4:notes

- OCCI Client code inside OpenNebula

```
$ git clone git://opennebula.org/one.git
```

dsa-research.org

Hands On

Setting up the accounts

Environment

```
$ cd one

$ ./install.sh –d $HOME/occiclient –c occi

$ export ONE_LOCATION=$HOME/occiclient

$ export PATH=$PATH:$ONE_LOCATION/bin

$ export OCCI_URL=https://devel.cloud.opennebula.org
```

Authorization

```
$ mkdir $HOME/.one
$ echo `whoami`:ogf28 > $HOME/.one/one_auth
```

- OCCI accounts
  - same usernames, password = ogf28

dsa-research.org

Hands On

Storage

- Upload disabled in public cloud
- Common operations
  - List pool
  - Show details of one STORAGE resource
  - Upload image

```
/var/tmp/occi-examples/image.xml
```

dsa-research.org

Hands On

Creating a Network

- RANGED networks
  - Network address
  - Size
- Common operations
  - List pool
  - Create NETWORK resource
  - Show details
  - Delete network

/var/tmp/occi-examples/network.xml

dsa-research.org

Hands On

Managing a Compute Resource

- COMPUTES uses
  - NETWORKS
  - STORAGE
- Common operations
  - List pool
  - Create COMPUTE resource
  - Show details
  - Update state
  - Delete compute

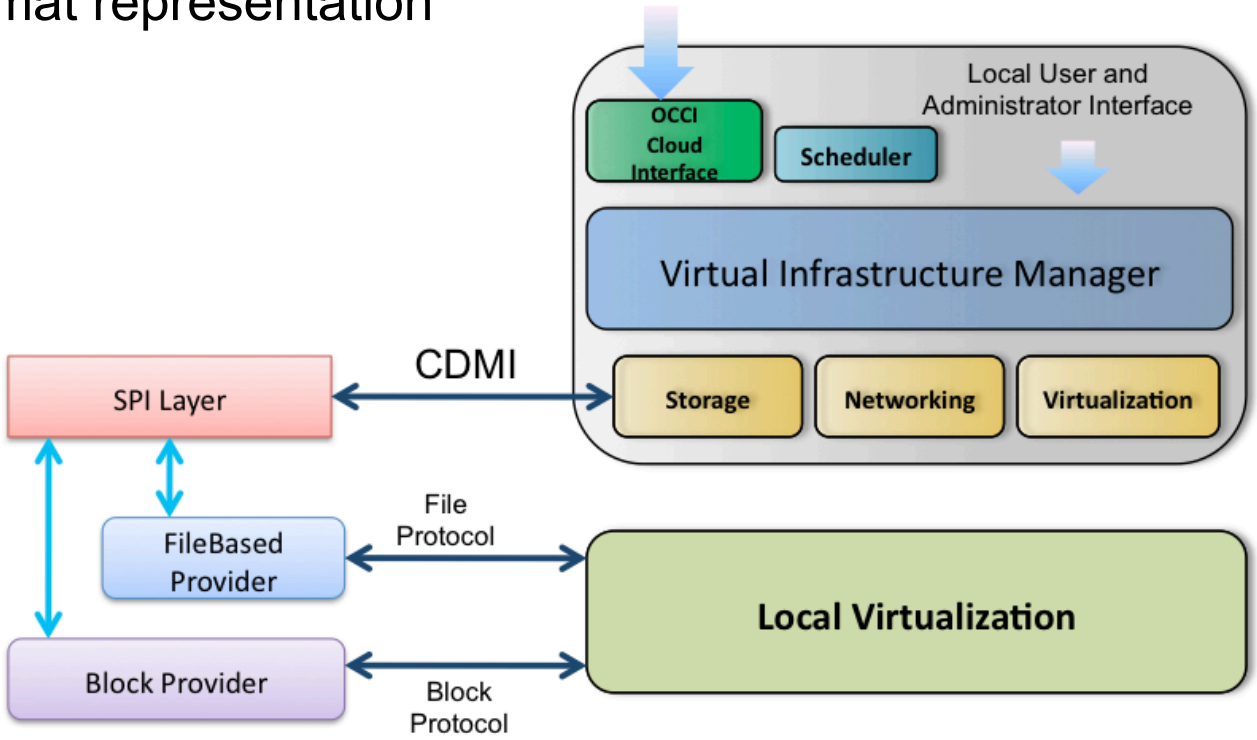
```
/var/tmp/occi-examples/compute.xml
```

CDMI/OCCI

Connecting standards

http://snia.org/cloud

- Joint demo in OGF 29 @ Chicago, June 2010
- Cloud computing infrastructure can implement OCCI and CDMI
  - RESTful HTTP interface
  - JSON format representation



dsa-research.org

OCCI Implementation on top of OpenNebula

THANK YOU FOR YOUR ATTENTION!!!
More info, downloads, mailing lists at
www.OpenNebula.org

OpenNebula is partially funded by the “RESERVOIR– Resources and Services Virtualization without Barriers” project
EU grant agreement 215605

www.reservoir-fp7.eu/

Acknowledgements

- Ignacio M. Llorente
- Javier Fontán
- Rubén S. Montero
- Rafael Moreno
- Jaime Melis